The smell of fungi – Basidiomycetes as flavor producers

F. F. Brescia[1], S. Yalman[1], R. C. Wende[2], M. A. Fraatz[1], and H. Zorn[1]

[1]Institute of Food Chemistry and Food Biotechnology and [2]Institute of Organic Chemistry, Justus Liebig University Giessen, Heinrich-Buff-Ring 17, 35392 Giessen, Germany

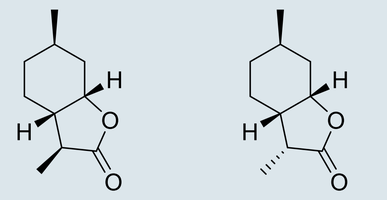
Introduction

The growing demand for natural food ingredients has increased interest in biotechnological production processes for natural flavors. Fungi of the phylum Basidiomycota have proven to be a promising source, producing not only typical C8 volatiles but also arylic compounds (e.g., *p*-anisaldehyde), less well-known bicyclic terpenoids (e.g., dill ether and dihydromenthofurolactones), and sulfur-containing volatiles (e.g., 2-methyl-3-(methylthio)furan). Structural identification, stereoselective analyses, and elucidation of biosynthetic pathways, including enzymes involved, require complex analytical chemistry, the use of labeled precursors, and bioinformatics methods.

Results and Discussion

Cystostereum murrayi

MDGC system

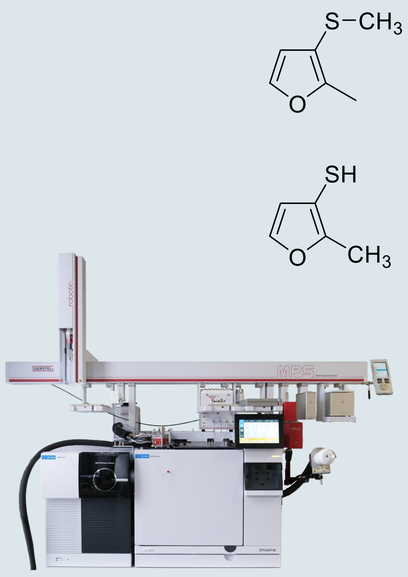


14a (3*S*,3a*S*,6*R*,7a*S*)

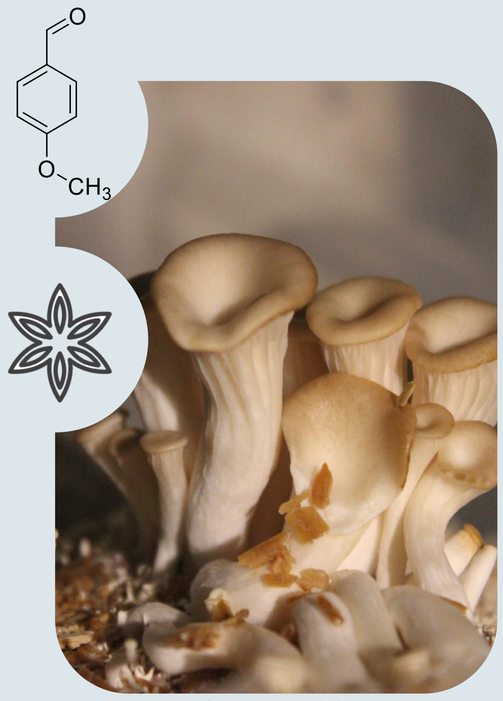
15c (3*R*,3a*S*,6*R*,7a*S*)

Cystostereum murrayi forms rare stereoisomers of dihydromenthofurolactones, which have been rarely described in nature thus far. Due to the presence of four stereogenic centers, 16 different stereoisomers are possible. Through NMR experiments and chiral multidimensional gas chromatography, two stereoisomers were structurally identified, one of which (**14a**) has one of the lowest odor thresholds, at 1.9 x 10^{-6} ng L^{-1} air, as determined by means of a novel approach for odor threshold determination in air.

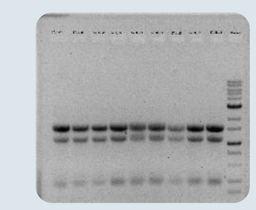
Laetiporus sulphureus, L. montanus, and *L. persicinus* form 2-methyl-3-furanthiol and its methylated derivate, 2-methyl-3-(methythio)furan, which contribute to the meaty odor during submerged cultivation with vitamin B1 supplementation. Labeling studies clearly demonstrated a formation of these compounds starting from thiamine.



Laetiporus montanus („Chicken of the woods“)

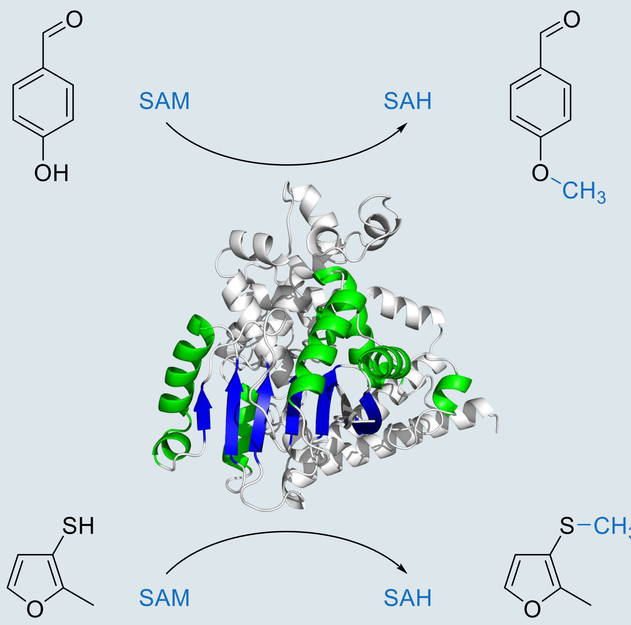


Pleurotus sapidus



RNA analyses

GC-MS analyses



Correlation of aroma and transcriptomic analyses enabled the identification of a novel *O*(*S*)-methyltransferase (OMT) catalyzing the formation of *p*-anisaldehyde in *Pleurotus sapidus*. Heterologous enzyme expression and crystallization experiments allowed a characterization of the enzyme. Besides *p*-hydroxybenzaldehyde, other hydroxylated aromatic compounds at *meta*- and *para*-position, as well as the 2-methyl-3-furanthiol, were methylated.